INNER PAPER GUIDE FOR MEDIA SHAPE CONTROL IN A PRINTER

TECHNICAL FIELD OF THE INVENTION

This invention relates to media handling apparatus, and more particularly to techniques for reducing trailing edge print defects in printing devices with media-handling rollers.

BACKGROUND OF THE INVENTION

Inkjet printers typically have an input media source such as a media stack in an input tray, an output tray, a media path between the input source and the output tray, and an inkjet printing apparatus located along the media path at a print area. The printing apparatus can comprise one or more inkjet printheads with nozzle arrays which emit droplets of ink onto the print media at the print area. A media handling apparatus is provided to pick the input media from the input source, feed the picked medium along the media path to the print area, and eject the picked medium onto the output tray after printing operations on the medium are completed.

In a typical sheet-fed printer using print media in sheet form, such as paper, a pick roller is employed to pick the top sheet of print media from the input tray and advance the picked sheet along the media path toward the printing apparatus. This is illustrated in the diagrammatic view of FIG. 1, wherein the pick roller 10 with associated pinch roller 13 has picked the sheet 12 from an input source (not shown), and pulled the sheet around the input guide 15 with curved guide surface 15A. The sheet handling apparatus further typically includes a feed or drive roller 14 and a forward pinch roller 16 which create a nip into which the leading edge of the picked sheet is fed by the pick roller along guide 18. The print zone at which printing operations are conducted is typically located on the media path just downstream of the pinch roller 16. Stresses are applied to the picked sheet at the print zone for media shape control and wet cockle control.

A problem arises in that the trailing edge 12A of the picked sheet is unconstrained after leaving the pick roller. Because of the stresses applied to the picked sheet in the print zone, the unconstrained shape of the sheet after leaving the pick roller is significantly rotated about the forward pinch roller 16. This is illustrated in FIG. 1, in which the constrained state prior to leaving the pick roller 10 and pinch roller 13 is indicated as sheet 12 with trailing edge 12, and the unconstrained state is indicated as sheet 12' with trailing

edge 12A'. This results in a rapid print medium shape change in stiff media that can cause an effective overfeed as seen by the print head just downstream of the nip between the drive roller and pinch roller. The effective overfeed causes a print defect, known as a "bottom of form" (BOF) print defect. This print defect is often quite visible on images printed on premium photo paper, for example.

Another cause of print defects for media handling apparatus incorporating separate roller wheels instead of solid rollers, is that, as the print medium is compressed under pinch rollers, energy is stored in the medium by deforming the print medium around the rollers. This is illustrated in the cross-section view of FIG. 2, taken transversely to the media path. Here the pick roller structure and the pinch roller structure is defined by three spaced pick roller wheel/pinch wheel pairs, 10A/13A, 10B/13B and 10C/13C. The deformation of the medium 12 in the regions between the wheel pairs is illustrated in exaggerated form in FIG. 2. This deformation can cause overfeeding, especially on stiff medias, when the trailing edge of the medium leaves the nip between the drive and pinch rollers.

These print defects will generally be described as "trailing edge" print defects, i.e. those print defects occurring when the trailing edge of the print media passes some point, e.g. a pinch point or the pick roller.

It would therefor be an advantage to provide a technique to minimize or eliminate trailing edge print defects in printing systems using media handling apparatus with one or more rollers.

SUMMARY OF THE INVENTION

In accordance with an aspect of the invention, a media handling system is described for handling sheets of media. The system includes a pick roller having a circumferential media-contacting surface and arranged for rotation about a roller axis to contact and pick a sheet from an input source. A drive roller is arranged for rotation about a drive roller axis, with a media path extending between the pick roller and the drive roller. A first guide structure is positioned along a first longitudinal edge of the media path and providing a first media guide surface. A second guide structure is positioned along a second longitudinal edge of the media path and provides a second media guide surface. The first and second guide surfaces are positioned to constrain the movement of a media sheet in the media path between the pick roller and the drive roller, thereby alleviating

trailing edge print defects.

BRIEF DESCRIPTION OF THE DRAWING

These and other features and advantages of the present invention will become more apparent from the following detailed description of an exemplary embodiment thereof, as illustrated in the accompanying drawings, in which:

FIG. 1 is a diagrammatic side view of a paper handling apparatus in which the trailing edge of the picked sheet is unconstrained after leaving the pick roller.

FIG. 2 is a cross-sectional view taken transversely with respect to the media path, of a system using separated pick/pinch wheel pairs, illustrating the media deformation due to energy storage in the print medium.

FIG. 3 is a diagrammatic side view of a print media handling apparatus in which the trailing edge of the picked sheet is constrained between two media guides after leaving the pick roller.

FIG. 4 is a cross-sectional view taken transversely with respect to the media path of a print media handling apparatus in which the medium is constrained between the nips of the drive roller wheels and corresponding pinch roller wheels.

FIG. 5 is a diagrammatic side view of an inkjet printer, showing the media path through the printer.

FIG. 6 is a simplified, partially-broken-away isometric view of the printer of FIG. 5.

FIG. 7 is a top view of the inner media guide of the printer of FIG. 5.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

One aspect of the invention is illustrated in FIG. 3. Here a sheet handling system 50 is illustrated, wherein a pick roller 52 is driven in a counterclockwise (CCW) direction as indicated by arrow A to pick a sheet of a medium such as paper, transparency or the like from an input source (not shown in FIG. 3), and transport the sheet into a media path. The system further includes a drive roller 56 and a pinch roller 58, positioned so as to create a nip 60 between adjacent surfaces of the respective rollers 56, 58. The drive roller 56 is driven in a CCW direction as indicated by arrow B. The media path passes through the nip 60, wherein the picked sheet is passed from the pick roller into the nip 60, and then is driven by the drive roller along a further portion of the media path. Typically a print area

is provided just downstream of the pinch roller 58, where printing operations are conducted.

In accordance with an aspect of the invention illustrated in FIG. 3, the media path 54 between the pick roller and the drive roller is defined by an upper guide surface 62 and a lower guide surface 64. The lower guide surface constrains the movement of the trailing edge 12A" of the sheet 12" resulting in the constrained sheet shape illustrated in FIG. 3. This prevents rotation of the paper about the front pinch roller 58, as would otherwise occur in the absence of a lower guide surface.

In exemplary embodiments, the spacing between the upper guide surface 62 and the lower guide surface 64 is increased from the media entrance location adjacent the pick roller to the media exit location adjacent the drive roller, thus providing a tapered media path between the guide. The spacing distance between the will depend on the particular system and media requirements; a typical range is from .5 mm to 5 mm. In an exemplary embodiment for addressing BOF print defects, the spacing between the upper and lower guide surfaces is from 2.9 mm at the media entrance location to 3.6 mm at the media exit location adjacent the drive roller.

FIG. 4 illustrates another aspect of the invention, wherein a lower media guide surface 66 is positioned below the upper guide surface 18 and below the nips of the pick wheel/pinch roller wheel pairs. The lower guide surface 66 supports the print medium 12 between pinch roller wheel positions, reducing the energy stored in the medium due to compression at the nips. The lower guide surface 66 also facilitates backing the print media up in a duplexing operation. For this aspect, it is desirable that the spacing between the upper guide surface and the lower guide surface at the nip between the pick roller wheels and pinch rollers be relatively small, e.g. in the range .5 mm to 2 mm. The closer the spacing, the more tightly is controlled the deformation of the print media when engaged between the nip. The spacing can then be gradually increased to provide a taper between the two guide surfaces. For example, the spacing at the media exit point adjacent the drive roller can be on the order of 2.5 mm to 5 mm.

Either aspect of the invention, or both aspects, as illustrated in FIGS. 3 and 4 can be employed in apparatus using sheet feeding systems. For example, an inner or lower guide surface can be implemented to address only the BOF print defect, wherein the guide surface is not required to extend between nips between pick roller wheels and pinch roller wheels. Another alternative is to provide an inner surface to support the print media at the

nips between pick roller wheels and pinch roller wheels, as shown in FIG. 4, without requiring the inner guide surface to extend to the drive roller to address BOF defects. A further alternate embodiment is to address both types of print defects, and this is illustrated in FIGS. 5-7.

FIGS. 5-7 depict in simplified form an inkjet printer 100 employing this invention. While it is apparent that the printing device components may vary from model to model, the inkjet printer 100 includes a frame or chassis surrounded by a housing, casing or enclosure 102, typically made of a plastic material. Sheets of print media are fed through a print zone 106 by a print media handling system. The print media may be any type of suitable material, such as paper, card-stock, transparencies, photographic paper, fabric, mylar, metalized media, and the like, but for convenience, the illustrated embodiment is described using paper as the print medium.

The print media handling system has an input supply feed tray 108 for storing sheets of print media before printing. A pick roller structure 130 and a drive roller structure 132 (FIG. 6) driven by a motor and drive gear assembly (not shown) may be used to move the print media from the feed tray 108, through the print zone 106, and, after printing, onto a pair of extended output drying wing members (not shown). The wings momentarily hold a newly printed sheet of print media above any previously printed sheets still drying in an output tray 110, then retract to the sides to drop the newly printed sheet into the output tray 110. The media handling system may include a series of adjustment mechanisms for accommodating different sizes of print media, including letter, legal, A-4, envelopes, etc., such as a sliding length adjustment lever 112, a sliding width adjustment lever 114, and an envelope feed port 116.

Although not shown, it is to be understood that the media handling system may also include other items such as one or more additional print media feed trays. Additionally, the media handling system and printing device 100 may be configured to support specific printing tasks such as duplex printing and banner printing.

Printing device 100 also has a printer controller, such as a microprocessor, that receives instructions from a host device, typically a computer, such as a personal computer (not shown). Many of the printer controller functions may be performed by the host computer, including any printing device drivers resident on the host computer, by electronics on board the printer, or by interactions between the host computer and the electronics. As used herein, the term "printer controller" encompasses these functions,

whether performed by the host computer, the printer, an intermediary device between the host computer and printer, or by combined interaction of such elements. The printer controller may also operate in response to user inputs provided through a key pad 118 located on the exterior of the casing 102. A monitor (not shown) coupled to the computer host may be used to display visual information to an operator, such as the printer status or a particular program being run on the host computer. Personal computers, their input devices, such as a keyboard and/or a mouse device, and monitors are all well known to those skilled in the art.

A carriage guide rod 120 is supported by the printer chassis to slidably support an inkjet pen carriage 122 for travel back and forth across print zone 106 along a scanning axis. Carriage 122 is also propelled along guide rod 120 into a servicing region located within the interior of housing 102. A conventional carriage drive gear and motor assembly (both of which are not shown) may be coupled to drive an endless loop, which may be secured in a conventional manner to carriage 122, with the motor operating in response to control signals received from the printer controller to incrementally advance carriage 122 along guide rod 120.

The end of the input media stack held in the input tray 108 adjacent the pick roller is raised by a pressure plate 148, to bring the leading edge of the top sheet into contact with the pick roller. As the pick roller is rotated, the top sheet is drawn around the periphery of the pick roller, through the nips between the pick roller 130 and pinch rollers 154A, 154B, 154C, and contact with guide surface 156 defined by curved guide 150 and support structure 152. The pressure plate is dropped to the lowered state shown in FIG. 6 after the top sheet has been picked. The pressure plate operation per se is well known in the art.

In print zone 106, the media sheet receives ink from an inkjet cartridge, such as an ink cartridge 124; the carriage can also hold a tricolor cartridge, or three monochrome color ink cartridges, to provide color printing capabilities. The cartridges each comprise a replaceable ink cartridge system wherein each pen has a reservoir that carries the entire ink supply as the printhead reciprocates over print zone 106 along the scan axis, or can include small reservoirs for storing a supply of ink in what is known as an "off-axis" ink delivery system. It should be noted that the present invention is operable in both off-axis and on-axis systems.

Referring now to FIG. 6, the media handling system of the printer 100 includes an

upper media or paper guide structure 140 providing an upper guide surface 140A, which together with a portion of the curved guide surface 156 extends along the media path portion 144 extending between the pick roller and the drive roller. A lower media or paper guide structure 142 provides a lower guide surface 142A in accordance with the invention, constraining the movement of the picked sheet in the portion of the paper path between the pick roller and the drive roller. For static control, the guide structure 142 is formed with a plurality of spaced ribs 142A extending along the media path direction and protruding from the structure surface 142B. The ends of the ribs provide the media contacting surfaces. The pick roller structure includes three spaced pick wheels 130 mounted on a shaft 144 for rotation. Wheels 146 are provided to assist in proper advancement of media such as envelopes through the media path. Slots 142C are formed in the guide structure 142 to allow the media contacting surface to extend between the rollers to provide support and prevent deformation of the print media in the regions between the rollers 130 and 146, as is more generally illustrated in FIG. 4. The spacing between the guide surfaces of the lower guide 142 and the upper guide surface defined in this exemplary embodiment by a portion of the curved surface 156 is preferably as small as possible for a given application. An exemplary suitable range for this spacing is between .5 mm and 2.0 mm.

The lower paper guide 142 constrains the movement of the picked sheet, holding it close to the upper guide surface, and maintains the constrained paper shape through the printing operation, until the trailing edge of the paper leaves the inner paper guide. This reduces or eliminates the trailing edge defects, as long as the lower paper guide surface effectively controls the back edge of the paper during the entire print operation at the print zone.

The lower paper guide surface can also help reduce or eliminate print defects associated with disturbances earlier in the media path, by preventing the formation of a buckle in the paper sheet between the pick roller and the drive roller which can result in overfeeds. Another advantage of the lower paper guide is that it can also help reduce paper jams caused by heavily curled media diving below the drive roller. The inner paper guide also reduces card and envelope smearing by maintaining the constrained paper shape.

It is understood that the above-described embodiments are merely illustrative of the possible specific embodiments which may represent principles of the present invention. Other arrangements may readily be devised in accordance with these

principles by those skilled in the art without departing from the scope and spirit of the invention.